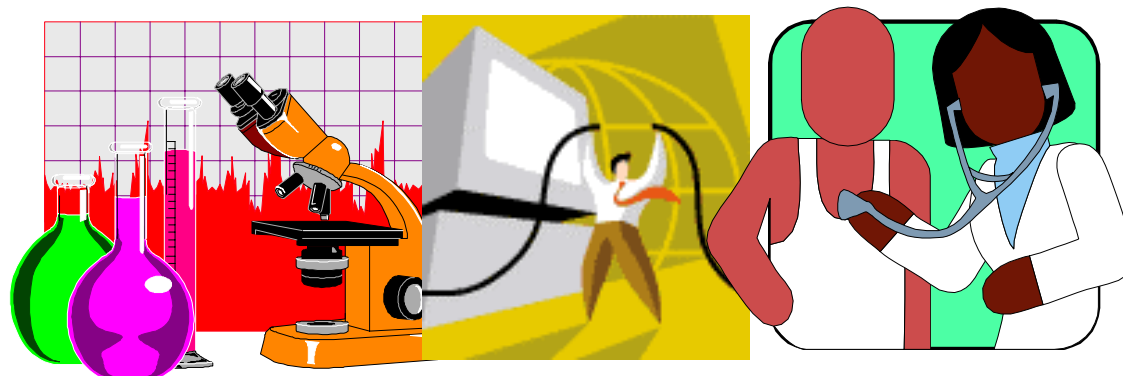# caBIG/ClinTrials Workspace/Lab Interface SIG
Lab Testing Ontology: Learning from HL7

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Overview

- Purpose: what can we learn from HL7 about handling laboratory test results?

- Introductory lab testing terms

- HL7 v2.x Laboratory result messages

- What about lab results & LOINC?

- What will HL7 v3 do to what we do now?

Introductory lab testing terms

- Orderable Test (e.g., Blood Gas)
  - Appears on lab order forms
    - has a local order code (e.g., ABG for Arterial Blood Gas)
    - has a CPT (Current Procedural Terminology) code
- Non-orderable Test (e.g, pH of arterial blood)
  - A component test of an orderable test
    - PaO_2, $PaCO_2$, O_2, SaO_2, HCO_3 and pH are the components of the orderable "Blood Gas"
    - Sodium, Potassium, Bicarb, Chloride are the non-orderable components of the "Electrolytes" orderable test
    - usually doesn't have a local order code so can't be ordered by itself
    - reportable even though not orderable
    - reported with other components of an orderable test
    - Non-orderable components often dictated by lab analyzer technology and/or local practice
- Battery, Panel, Profile (e.g., Admission Battery)
  - An orderable test encompassing a group of orderable tests
    - An Admission Battery might be comprised of the four following orderable tests; CBC, Lytes, AST, and Urinalysis

Ordered Test Codes

University Hospitals
Laboratory Services

11400·11100 Euclid Avenue · Cleveland, OH 44106-5199

(216)844-5227 · FAX (216)844-7560

RUBEN, BILLY
MRN: 3342233

BIRTHDATE SEX: 12/28/19   F
PATIENT #:   02351804
ORDERED: 07/16/01 10:56
ROOM# BED:

REQUESTED BY: OVERMOYER, BETH,
ATT. PHYSICIAN: OVERMOYER, BETH,

ADDT'L COPY TO:

FINAL

TEST NAME		RESULTS	REF VALUES	UNITS	TS

HEMATOLOGY

COLLECTED 07/16/01 10:56

CBC → COMPLETE BLOOD COUNT
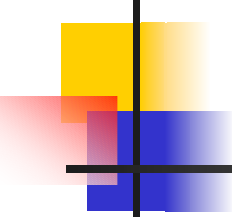
TEST NAME		RESULTS	REF VALUES	UNITS	TS
WBC	H	16.4	4.4-11.3	X10E9/L	UH
RBC		4.02	4.00-5.20	X10E12/L	UH
HGB	L	10.6	12.0-16.0	g/dL	UH
HCT	L	33.0	36.0-46.0	%	UH
MCV		82	80-100	fL	UH
MCH		26.4	26.0-34.0	pg	UH
MCHC		32.1	32.0-36.0	%	UH
PLT		228	150-450	X10E9/L	UH
RDW-CV	H	15.8	11.5-14.5	%	UH
MPV		10.6	7.2-11.1	fL	UH

DIFF → DIFFERENTIAL

TEST NAME		RESULTS	REF VALUES	UNITS	TS
SEG NEUTROPHIL		21.0		%	UH
BAND NEUTROPHIL		28.0		%	UH
LYMPHOCYTE		11.0		%	UH
MONOCYTE		17.0		%	UH
EOSINOPHIL		0.0		%	UH
BASOPHIL		0.0		%	UH
METAMYELOCYTE		10.0		%	UH
MYELOCYTE		13.0		%	UH
SEG NEUTROPHIL		3.44	1.20-7.00	X10E9/L	UH
BAND NEUTROPHIL	H	4.59	0.00-0.70	X10E9/L	UH
LYMPHOCYTE		1.80	1.20-4.80	x10E9/L	UH
MONOCYTE	H	2.79	0.10-1.00	X10E9/L	UH
EOSINOPHIL		0.00	0.00-0.70	x10E9/L	UH
BASOPHIL		0.00	0.00-0.10	x10E9/L	UH
METAMYELOCYTE		1.64	Occ	x10E9/L	UH
MYELOCYTE		2.13	Occ	x10E9/L	UH

What is HL7? (Health Level Seven)

- an application protocol for data exchange between computer systems in health care environments
- defines the messages as they are exchanged and the procedures used to exchange them
- independent of operating systems and programming languages

HL7 messages are made up of segments

- HL7's Unsolicited Observation Message (ORU) is sent out by the LIS when a lab result is completed
- The ORU Message must contain the following segments:
    - MSH Message Header (information about the message)
    - PID Patient Identification (information about the patient)
    - OBR Observation Request (information about the order)
    - OBX Observation Report (information about a result)
- Sometimes the ORU will also have PV (patient visit), ORC (order common) and NTE (note) segments but lets keep things simple

Message Subject Heading (MSH) Segment

- All messages begin with a MSH segment
  - Defines the intent, source, destination and syntax of a message
- Contains fields such as
  - Sending Application (MSH.3)
  - Sending Facility (MSH.4)
  - Receiving Facility (MSH.6)
  - Message Type (MSH.9)
- MSH example
- MSH|^~\&|PATHLAB|MERCY||GP009|200207251030||ORU^R01|CNTRL-3458|P|2.4

HL7 Tip

Fields are separated by vertical bars "|"

The Patient Identification Segment (PID)

- PID segment includes;
- includes fields such as:
  - Patient Identifier list (PID.3)
  - Patient Name (PID.5)
  - Date/Time of Birth (PID.7)
  - Administrative Sex (PID.8)
  - Patient Address (PID.11)
- PID example
  PID|||666442222^^^MERCY^MR||MULLINS^LARRY||1956
  0312|M|||6 ASHWOOD DRIVE^^RATHFARNHAM^DUBLIN

HL7 Tip
Fields may consist of components separated by ^
For example, patient name field consists of |LastName ^ FName ^ MI

ORU Laboratory Report Message

- MSH| ...
- PID| ...

Ordered Test

Collection Date/Time

- OBR|1||1045814^PATHLAB|85022^HB|||200207250830|||||
  ||||75555^COLLINS^PATRICIA^^^^MB||||||||F

Ordering Provider

Observation identifier

- OBX|1|ST|718-7^HEMOGLOBIN:^LN||13.4|GM/DL|14-18|
  N||S|F

Abnormal Flag

Result Status (F is final)

Value Units

Ref Range

Blood Gas example
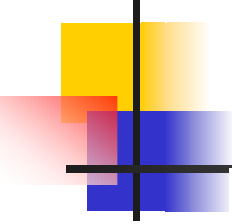## (with a note segment, NTE)

- MSH …
- PID …
- OBR|1||1045825^LAB|L2560.000^BLOOD GAS, ARTERIAL (R)||||19940320105800|""| 1^EA||||||19940320105800||CARMI|||||||19940320105844|||F
- OBX|1|ST|L2565.000^PH, ARTERIAL BLD GAS (R)||7.46||7.35-7.45|H|||F
- OBX|2|ST|L2566.000^PCO2, ARTERIAL BLOOD GAS||28|mm/Hg|35-45|LL|||F
- **NTE**|1|L|BLOOD GAS ANALYSIS CRITICAL VALUE(S) CALLED TO~DR. CARLSON.
- OBX|3|ST|L2567.000^PO2, ARTERIAL BLOOD GAS||83|mm/Hg|80-100||||F
- OBX|4|ST|L2568.000^O2 SAT, ART BLD GAS (R)||96|%|95-99||||F
- OBX|5|ST|L2569.000^BASE EX, ARTERIAL BLD GAS||-2.1|mEq/l|-2.0-2.0|L|||F
- OBX|6|ST|L2570.000^HCO3, ARTERIAL BLD GAS||19.4|mEq/l|22-26|L|||F
- OBX|7|ST|L2571.000^PATIENT TEMP, ABG||96.2|deg F|||||F
- OBX|8|ST|L2572.000^MODE, ABG||ROOM AIR||||||F

■ http://www.loinc.org/

LOINC for coding lab results

Where does LOINC fit in HL7?

Observation ID   Observation value   Reference range

Units

OBX|1|NM|10839-9^TROPONIN-I^LN||5|ng/ml|0-1.3|H||H|F|19980309…

Abnormal flag

OBX|2|NM|13969-2^CK MB-MASS^LN||24|ug/L|0-6|H||H|F|19980309…

LOINC code
for CK MB-Mass

Identifies coding system as LOINC

Says patient had a serum troponin value of 5 ng/mL, and a serum CK MB value of 24 ug/L.

From www.loinc.org

LOINC's Axes

Table 2. LOINC axes.

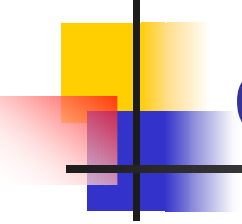| Number	Description
1	Component (analyte): e.g., potassium, hemoglobin, hepatitis B antigen
2	Property measured: e.g., a mass concentration, enzyme activity (catalytic rate)
3	Timing: i.e., whether the observation applies to a moment in time or is an average or amount taken over a period of time, as is the case for a 24-h urine sodium concentration
4	System: i.e., type of sample or organ examined: e.g., urine, blood, chest
5	Scale: e.g., whether the measurement is quantitative (a true measurement), ordinal (a ranked set of options), nominal, or narrative (e.g., dictation results from x-rays)
6	Method used to produce the observation, but only when different methods give clinically significant different results

McDonald CJ, et al. *Clin Chem* 2003;49:624-33.

Will 5 axes be adequate?

Table 1. Examples of laboratory LOINC codes and formal LOINC names.

LOINC code	LOINC name (component:property:timing:specimen:scale)
2951-2	SODIUM:SCNC:PT:SER/PLAS:QN
2955-3	SODIUM:SCNC:PT:UR:QN
2956-1	SODIUM:SRAT:24H:UR:QN
2164-2	CREATININE RENAL CLEARANCE:VRAT:24H:UR:QN
1514-9	GLUCOSE^2H POST 100 G GLUCOSE PO:MCNC:PT:SER/PLAS:QN
3665-7	GENTAMICIN^TROUGH:MCNC:PT:SER/PLAS:QN
17863-2	CALCIUM.IONIZED:MCNC:PT:SER/PLAS:QN
2863-9	ALBUMIN:MCNC:PT:SNV:QN:ELECTROPHORESIS

Or will we want to differentiate manual from automated diff results by including the 6th axis, Method?

McDonald CJ, et al. *Clin Chem* 2003;49:624-33.

What will HL7 v3 do to what we do now?

- I doubt that anything will go away
- But I'm not in the HL7 v3 Mood now
- To be continued?

Resources

- HL7 (Health Level Seven) Message Standards for Laboratory Results and Radiology Reports in Ireland 31/7/2003
  - This documents provides ready and succinct description of all the HL7 fields that might appear in a lab results message.
  - http://www.hebe.ie/ProgrammesProjects/e-Government/SubProjects/GPMessagingProject/Documentation/FiletoUpload,1641,en.pdf
- LOINC homepage
  - http://www.loinc.org/
- McDonald CJ et al. LOINC, a universal standard for identifying laboratory observations: A 5-year update. *Clin Chem* 2003;49:624-33. (access full text via LOINC homepage under "Articles")
- Huff SM et al. Development of the Logical Observation Identifier Names and Codes (LOINC) vocabulary. *JAMIA* 1998;5:276-92. (access full text via PubMed)
- Schadow G et al. Integrating medical information and knowledge in the HL7 RIM. Proc AMIA Symp 2000;764-8.